

(19) World Intellectual Property Organization
International Bureau(43) International Publication Date
31 July 2003 (31.07.2003)

PCT

(10) International Publication Number
WO 03/062802 A3(51) International Patent Classification⁷: G01N 21/47,
A61B 3/00, G01B 9/02, H03L 7/00Somerville, MA 02145 (US). TEARNEY, Guillermo, J.
[US/US]; 118 Kinnaird Street, #3, Cambridge, MA 02139
(US). BOUMA, Brett, Eugene [US/US]; 12 Monmouth
Street, Quincy, MA 02171 (US).

(21) International Application Number: PCT/US03/02349

(74) Agent: BERNSTEIN, John A.; Powell, Goldstein, Frazer
& Murphy LLP, 16th Floor, 191 Peachtree Street, Atlanta,
GA 30303-1736 (US).

(22) International Filing Date: 24 January 2003 (24.01.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:

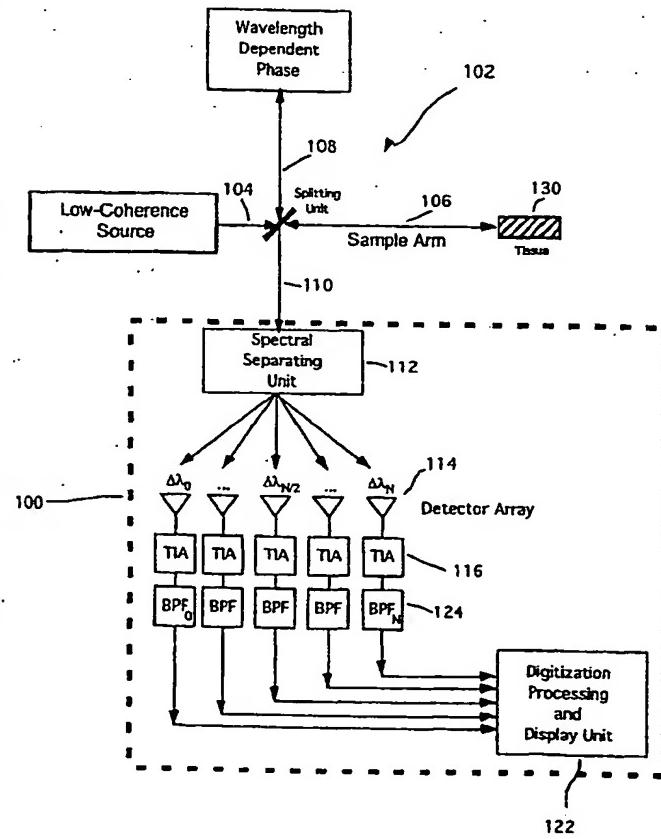
60/351,904 24 January 2002 (24.01.2002) US
10/136,813 30 April 2002 (30.04.2002) US(71) Applicant (for all designated States except US): THE
GENERAL HOSPITAL CORPORATION [US/US]; 55
Fruit Street, Boston, MA 02114 (US).(81) Designated States (national): AE, AG, AL, AM, AT, AU,
AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU,
CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH,
GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC,
LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW,
MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG,
SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN,
YU, ZA, ZM, ZW.

(72) Inventors; and

(84) Designated States (regional): ARIPO patent (GH, GM,
KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW),
Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM),(75) Inventors/Applicants (for US only): DE BOER, Johannes,
Fitzgerald [US/US]; 60 C Marshall Street,

[Continued on next page]

(54) Title: APPARATUS AND METHOD FOR RANGINGS AND NOISE REDUCTION OF LOW COHERENCE INTERFEROMETRY LCI AND OPTICAL COHERENCE TOMOGRAPHY (OCT) SIGNALS BY PARALLEL DETECTION OF SPECTRAL BANDS



WO 03/062802 A3

(57) Abstract: Apparatus, method, logic arrangement and storage medium are provided for increasing the sensitivity in the detection of optical coherence tomography and low coherence interferometry ("LCI") signals by detecting a parallel set of spectral bands, each band being a unique combination of optical frequencies. The LCI broad bandwidth source can be split into N spectral bands. The N spectral bands can be individually detected and processed to provide an increase in the signal-to-noise ratio by a factor of N. Each spectral band may be detected by a separate photo detector and amplified. For each spectral band, the signal can be band pass filtered around the signal band by analog electronics and digitized, or, alternatively, the signal may be digitized and band pass filtered in software. As a consequence, the shot noise contribution to the signal is likely reduced by a factor equal to the number of spectral bands, while the signal amplitude can remain the same. The reduction of the shot noise increases the dynamic range and sensitivity of the system.



European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

(88) Date of publication of the international search report:
4 December 2003

Published:

— with international search report

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G01N A61B G01B H03L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 134 003 A (BOPPART STEPHEN A ET AL) 17 October 2000 (2000-10-17) column 16, line 36 -column 17, line 24; figure 16 ---	1-58,71, 101,102
X	US 5 317 389 A (HOCHBERG ERIC B ET AL) 31 May 1994 (1994-05-31) column 5, line 45 -column 6, line 19; claims 1,2; figure 2 ---	1-58,71, 101,102
A	US 6 141 577 A (DELFYETT JR PETER J ET AL) 31 October 2000 (2000-10-31) column 4, line 50 -column 5, line 37; figure 3 ---	1-58,71, 101,102

 Further documents are listed in the continuation of box C. Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the International filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

11 September 2003

Date of mailing of the international search report

19.09.03

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Consalvo, D

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	TEARNEY G J ET AL: "IN VIVO ENDOSCOPIC OPTICAL BIOPSY WITH OPTICAL COHERENCE TOMOGRAPHY" SCIENCE, AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE,, US, vol. 276, no. 5321, 27 June 1997 (1997-06-27), pages 2037-2039, XP001041246 ISSN: 0036-8075 figure 1 ---	1-58,71, 101,102
A	WO 99 44089 A (GEN HOSPITAL CORP ;TEARNEY GUILLERMO J (US); BOUMA BRETT E (US); W) 2 September 1999 (1999-09-02) figure 1 ---	1-58,71, 101,102
X	US 4 925 302 A (CUTLER GREGORY M) 15-May 1990 (1990-05-15) column 5, line 14 -column 6, line 25; figures 3,4 ---	59-69, 85,86, 88-90, 92,93,98
X	US 4 631 498 A (CUTLER GREGORY M) 23 December 1986 (1986-12-23) claims 1-6; figure 1 ---	59-69, 85,86, 88-90, 92,93,98
A	GB 2 209 221 A (LITTON SYSTEMS INC) 4 May 1989 (1989-05-04) figure 6 ---	59-69, 85,86, 88-90, 92,93,98
A	US 6 069 698 A (TAKIZAWA HIRONOBU ET AL) 30 May 2000 (2000-05-30) the whole document ---	59-69, 85,86, 88-90, 92,93,98
A	US 5 491 552 A (KNUETTEL ALEXANDER) 13 February 1996 (1996-02-13) column 3, line 41 -column 7, line 62 ---	59-69, 85,86, 88-90, 92,93,98
A	US 5 321 501 A (HUANG DAVID ET AL) 14 June 1994 (1994-06-14) column 6, line 22 -column 9, line 2; figure 1A ---	59-69, 85,86, 88-90, 92,93,98

Patent document cited in search report		Publication date		Patent family member(s)	Publication date
US 6134003	A	17-10-2000	US US AU EP JP JP US US WO US US US US US US US US US US US US WO US US US WO WO DE DE EP JP WO US US	5748598 A 5459570 A 1977597 A 0883793 A1 2000503237 T 2002214127 A 6485413 B1 6111645 A 9732182 A1 6160826 A 6564087 B1 6501551 B1 6282011 B1 5956355 A 2001036002 A1 9701167 A1 5784352 A 9723870 A1 9533970 A1 69227902 D1 69227902 T2 0581871 A1 6511312 T 9219930 A1 5465147 A 5321501 A	05-05-1998 17-10-1995 16-09-1997 16-12-1998 21-03-2000 31-07-2002 26-11-2002 29-08-2000 04-09-1997 12-12-2000 13-05-2003 31-12-2002 28-08-2001 21-09-1999 01-11-2001 09-01-1997 21-07-1998 03-07-1997 14-12-1995 28-01-1999 17-06-1999 09-02-1994 15-12-1994 12-11-1992 07-11-1995 14-06-1994
US 5317389	A	31-05-1994	US US	5071251 A 5054924 A	10-12-1991 08-10-1991
US 6141577	A	31-10-2000	US US	5921926 A 6072765 A	13-07-1999 06-06-2000
WO 9944089	A	02-09-1999	AU AU EP JP WO US US	758078 B2 2882399 A 1057063 A1 2002505434 T 9944089 A1 6341036 B1 2002122246 A1	13-03-2003 15-09-1999 06-12-2000 19-02-2002 02-09-1999 22-01-2002 05-09-2002
US 4925302	A	15-05-1990		NONE	
US 4631498	A	23-12-1986	US	4746878 A	24-05-1988
GB 2209221	A	04-05-1989		NONE	
US 6069698	A	30-05-2000	JP JP JP	11072431 A 11056752 A 11148897 A	16-03-1999 02-03-1999 02-06-1999
US 5491552	A	13-02-1996	DE EP	4310209 A1 0618439 A1	06-10-1994 05-10-1994
US 5321501	A	14-06-1994	US DE DE EP	5465147 A 69227902 D1 69227902 T2 0581871 A1	07-11-1995 28-01-1999 17-06-1999 09-02-1994

Patent document cited in search report	Publication date		Patent family member(s)	Publication date
US 5321501	A	JP	6511312 T	15-12-1994
		US	5459570 A	17-10-1995
		US	6485413 B1	26-11-2002
		US	6111645 A	29-08-2000
		WO	9219930 A1	12-11-1992
		US	6160826 A	12-12-2000
		US	6564087 B1	13-05-2003
		US	6501551 B1	31-12-2002
		US	6282011 B1	28-08-2001
		US	6134003 A	17-10-2000
		US	5956355 A	21-09-1999
		US	2001036002 A1	01-11-2001

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. Claims Nos.: because they relate to subject matter not required to be searched by this Authority, namely:

2. Claims Nos.: because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. Claims Nos.: because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- The additional search fees were accompanied by the applicant's protest.
- No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-58, 71, 101, 102

apparatus for optical imaging employing an interferometer, a spectral separating unit, and a plurality of detectors.

2. Claims: 59-61, 62-66, 67-68, 69, 85-86, 88, 89, 90, 92, 93, and 98

apparatus for optical imaging employing an interferometer, a spectral separating unit, and a plurality of detectors.